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# **Final Report on the Clean Energy/ Air Quality Integration Initiative Pilot Project of the U.S. Department of Energy's Mid-Atlantic Regional Office**

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## **Preface**

This final report and its underlying analysis were developed through a collaboration between Debra Jacobson, professorial lecturer in law, George Washington University Law School and president, DJ Consulting LLC; Peter O'Connor, project manager, Global Environment & Technology Foundation; Dr. Colin High, vice president, Resource Systems Group; and John Brown, project leader for State and Local Initiatives, National Renewable Energy Laboratory. Dr. High and Messrs. O'Connor and Brown were responsible for the technical analysis, and Ms. Jacobson took the lead in the policy and legal analysis. For purposes of this report, these four individuals are referred to as the "project team." This work was conducted with the financial support of the U.S. Department of Energy (DOE). This report has been revised since hard copies were distributed.

The project team wishes to thank all those who reviewed and commented on the report, including Ellen Lutz and James M. Ferguson of DOE's Mid-Atlantic Regional Office, Jerry Kotas of DOE's Central Regional Office, the Climate Protection Partnership Division of the U.S. Environmental Protection Agency's (EPA) Office of Air and Radiation, EPA Regions II and III, Mike Winka, director of the Office of Clean Energy of the New Jersey Board of Public Utilities, Sandy Krietzman, Christine Schell, Melissa Evanago, and Tom McNevin of the New Jersey Department of Environmental Protection, Alden Hathaway of Environmental Resources Trust, Joe Romm of Global Environment & Technology Foundation, Arnold W. Reitze, Jr., chairman of the Environmental Law Department at the George Washington University Law School and J.B. and Maurice C. Shapiro, professors of Environmental Law, Jonathan Miles, professor at the Integrated Science and Technology Department at James Madison University, and Mike Ambrosio of Ambrosio Associates.

## Acronyms

CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CEP	Clean Energy Program
CFL	compact fluorescent light
C&I	commercial and industrial
CHP	combined heat and power
CO <sub>2</sub>	carbon dioxide
CORE	New Jersey Customer On-Site Renewable Energy Program
DOE	U.S. Department of Energy
EE	Energy Efficiency
EPA	U.S. Environmental Protection Agency
kWh	kilowatt-hour
HVAC	heating, ventilation, and air conditioning
MARO	U.S. Department of Energy Mid-Atlantic Regional Office
MWh	megawatt-hour
NO <sub>x</sub>	nitrogen oxides
NJ BPU	New Jersey Board of Public Utilities
NJ CEP	New Jersey Clean Energy Program
NJ DEP	New Jersey Department of Environmental Protection
NREL	National Renewable Energy Laboratory
OTC	Ozone Transport Commission
PV	photovoltaic
RE	renewable energy
REC	Renewable Energy Credit
RGGI	Regional Greenhouse Gas Initiative
SIP	State Implementation Plan
SREC	Solar Renewable Energy Certificate
STAC	State Technologies Advancement Collaborative

## Executive Summary

DOE, in cooperation with EPA, in Fiscal Year 2005 initiated the Clean Energy/Air Quality Integration Initiative to facilitate state efforts to improve air quality and increase the use of renewable energy (RE) and energy efficiency (EE) technologies. The initiative also seeks to facilitate the development of new state policies to further these objectives. This report summarizes the results of one of the four pilot projects supported by the initiative in FY 2005—the Mid-Atlantic Regional Office (MARO) pilot project.

The MARO pilot project represents the first effort in the country to seek to obtain credit under a Clean Air Act (CAA) State Implementation Plan (SIP) for nitrogen oxide (NO<sub>x</sub>) emission reductions. This project came about because of state-funded incentive programs and projects for RE and EE.<sup>1</sup> Specifically, the pilot project focuses on the New Jersey (NJ) SIP and efforts to facilitate attainment of the new, 8-hour ozone standard under CAA by implementing selected categories of RE and EE programs and projects funded by the New Jersey Clean Energy Program (NJ CEP) of the New Jersey Board of Public Utilities (NJ BPU).<sup>2</sup> The project is significant because of the broad scope of the RE and EE programs and projects considered, including: (1) EE projects in new construction and retrofits of commercial and industrial (C&I) and residential buildings and schools (36,000 projects); (2) Energy Star® air-conditioning (50,000 units) and lighting (3.5 million units); (3) high-efficiency central air-conditioning (50,000 units) and ground source heat pumps (1,000 units); and (4) solar photovoltaic projects (344 systems that total 2.5 MW).

During the pilot project, the project team refined and expanded an analytical framework developed by NJ BPU and the New Jersey Department of Environmental Protection (NJ DEP) and conducted its own extensive analysis. The team's analysis, which employed conservative assumptions, indicates that a subset of RE and EE measures implemented under the NJ CEP in 2002, 2003, and 2004 would result in the reduction of at least 240 tons of NO<sub>x</sub> emissions during the summer season of 2005 alone, based on summer electricity savings and RE generation of approximately 320,000 megawatt-hours (MWh).<sup>3</sup> Based on the expected continuation and growth of the NJ CEP, NO<sub>x</sub> emission reductions that result from that program and from private investments will likely exceed the current incentive allowance cap of 410 tons annually by 2007.

Preliminary estimates of potential NO<sub>x</sub> reductions during the summer ozone season of 2012 are 480–950 tons, depending on the specific assumptions that are used for program growth, duration

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<sup>1</sup> In May 2005, EPA approved the first-ever SIP credit for an RE measure in a SIP. This approval involved a wind purchase included in a revised SIP that was developed by the State of Maryland to meet the 1-hour ozone standard, 70 Fed. Reg. 24987 (May 12, 2005). Although this wind purchase was precedent setting, it involved only RE and did not include EE measures. It also did not involve state programs to provide financial incentives, such as rebates, to spur RE and EE use.

<sup>2</sup> EPA is expected to require states to submit revised SIPs to meet the 8-hour ozone standard by June 2007, and New Jersey plans to identify its planned control measures by 2006.

<sup>3</sup> This number includes savings from measures actually implemented through 2004. Other measures are “committed” to or under development.

of measures, and changes in the electricity grid.<sup>4</sup> This analytical foundation also can be applied to estimate annual NO<sub>x</sub> emission reductions for the period 2008 to 2013 for the NJ SIP for fine particulate matter. It also can be applied to determine carbon dioxide (CO<sub>2</sub>) emission reductions for New Jersey's participation in the Regional Greenhouse Gas Initiative (RGGI).

The project expanded methodologies to evaluate: (1) the amount of electricity savings; (2) the summer component of the electricity savings; and (3) the NO<sub>x</sub> emission reductions.<sup>5</sup> Also, approaches were developed to integrate various elements of the federal and state regulatory framework to ensure that RE and EE programs result in real emission reductions.<sup>6</sup> Moreover, the analytical and policy framework developed during the pilot project provides many valuable lessons to other states, including Pennsylvania and New York—two states with direct involvement in MARO's initial pilot project.<sup>7</sup> During the course of the project, the project team resolved challenges in estimating reductions in emissions of NO<sub>x</sub>, a pollutant that is subject to emissions trading (cap and trade) regulations in New Jersey and most eastern states. Thus, the team needed to integrate elements of: (1) EPA's requirements for crediting NO<sub>x</sub> emission reductions in SIPs; and (2) the implementation of New Jersey regulations that govern NO<sub>x</sub> emissions trading, including provisions to establish an RE and EE set-aside of NO<sub>x</sub> allowances for the summer ozone season.

The work accomplished during the pilot project has already proven useful to other states in developing new NO<sub>x</sub> emissions trading programs that are required under EPA's Clean Air Interstate Rule.<sup>8</sup> Such work should help states achieve the full air quality benefits of their RE and EE programs.<sup>9</sup>

This report contains a detailed list of "lessons learned" that other states can replicate. The pilot project has facilitated the resolution of numerous analytical and policy issues, and provides direction for other states to follow.

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<sup>4</sup> See pp. 13–17 (*infra*).

<sup>5</sup> The basic methodology for determining energy savings, the NJ Clean Energy Protocols, is attached as Appendix 3. Modifications and expansions are detailed on pp. 27–30 of this report.

<sup>6</sup> See pp. 20–27 (*infra*).

<sup>7</sup> Originally, the Mid-Atlantic pilot project was expected to include New Jersey, New York, and Pennsylvania and would parallel a separate State Technologies Advancement Collaborative (STAC) project that focused on regulatory barriers faced by distributed generation in the mid-Atlantic States. Following delays by outside parties in the issuance of the contract for the STAC project and the Request for Proposals associated with this project, MARO decided to revise the scope of the pilot project.

<sup>8</sup> 70 Fed. Reg. 25162 et seq. (May 12, 2005).

<sup>9</sup> New Jersey has regulatory advantages that facilitated the integration of clean energy and air quality goals that some other states may not possess. For example, New Jersey is one of only seven states that have adopted an EERE set-aside in their NO<sub>x</sub> emission trading regulations, and New Jersey's regulations contain a stipulated allocation rate that aided the conversion of energy savings into emission reductions. Lessons from the New Jersey experience that are relevant to other states are addressed in substantial detail in the final section of this report, titled "Lessons Learned."



## 1.0 Background

### 1.1 EPA Guidance Documents that Affect Energy Efficiency and Renewable Energy

In 2004, the U.S. Environmental Protection Agency (EPA) issued two important guidance documents to encourage innovative air pollution control measures, including renewable energy (RE) and energy efficiency (EE). EPA issued the first guidance document titled, *Guidance on State Implementation Plan (SIP) Credits for Emission Reduction Measures from Electric-sector Energy Efficiency and Renewable Energy Measures* in August 2004.<sup>10</sup> The purpose of this guidance is to “promote the testing of promising new pollution reduction strategies, such as energy efficiency and renewable energy, within the air quality planning process.”<sup>11</sup>

#### Highlights: Findings, Issues, and Lessons Learned

- The U.S. Department of Energy (DOE) Mid-Atlantic Regional Office (MARO) pilot project represents the first effort in the country to seek to obtain credit under a Clean Air Act State Implementation Plan (CAA SIP) for nitrogen oxide (NO<sub>x</sub>) emission reductions that result from state-funded incentive programs and projects for renewable energy (RE) energy efficiency (EE).
- Preliminary estimates of NO<sub>x</sub> reductions during the 2009 summer ozone season in New Jersey that result from the New Jersey Clean Energy Program (NJ CEP) are 370–560 tons. By 2012, NO<sub>x</sub> reductions are expected to be 480–950 tons.
- A state with a NO<sub>x</sub> emissions trading program will not be able to claim NO<sub>x</sub> emission reduction credit in its SIP to meet the 8-hour ozone standard unless several criteria are met. In most cases, two of the key criteria include: (1) adopting regulations under the Clean Air Interstate Rule (CAIR) that allocate a percentage of NO<sub>x</sub> allowances to support RE/EE measures; and (2) retiring allowances to ensure that the emission reductions are surplus.
- Most of the procedures developed by New Jersey and the pilot project to convert RE generation and EE savings into emission reduction estimates will be replicable in other states. These procedures allow NO<sub>x</sub> emission reductions from RE/EE measures to be estimated with a relatively small investment.

<sup>10</sup> U.S. Environmental Protection Agency, *Guidance on State Implementation Plan (SIP) Credits for Emission Reduction Measures from Electric-sector Energy Efficiency and Renewable Energy Measures*, August 2004 (hereinafter cited as *EPA SIP Guidance*). This document, the September 2004 voluntary measures guidance, and other documents are available at [www.epa.gov/cleanenergy/stateandlocal/guidance.htm](http://www.epa.gov/cleanenergy/stateandlocal/guidance.htm).

<sup>11</sup> *EPA SIP Guidance*, p. 1.

EPA issued the second guidance document titled, *Incorporating Voluntary and Emerging Measures in a State Implementation Plan (SIP)*, in September 2004. The purpose of this guidance is to facilitate efforts by state and local governments to include nontraditional control measures in their SIPs.

The major purpose of the two guidance documents is to assist areas of the country that are facing challenges in meeting air quality standards. EPA has designated 474 counties or portions of counties as nonattainment areas for the 8-hour ozone standard and 225 counties or portions of counties as nonattainment areas for fine particulate matter.<sup>12</sup>

## **1.2 Clean Energy/Air Quality Integration Initiative**

DOE established the Clean Energy/Air Quality Integration Initiative in late 2004 after the two EPA guidance documents were issued. This DOE initiative was undertaken in cooperation with EPA, several energy and environmental organizations,<sup>13</sup> and the National Renewable Energy Laboratory (NREL). Its purpose was “to demonstrate how state energy and environmental officials can work together on energy efficiency and renewable energy technologies and policies that improve air quality while they address energy goals.”<sup>14</sup> DOE designated four of its Regional Offices to develop pilot projects to pursue clean energy/air quality integration in the first phase of this initiative. This report summarizes the results of the pilot project in MARO.

The MARO pilot project represents the first effort in the country to seek to obtain credit under a Clean Air Act (CAA) SIP for nitrogen oxide (NO<sub>x</sub>) emission reductions that result from state-funded incentive programs and projects for both RE and EE. Specifically, the pilot project focuses on the New Jersey (NJ) SIP and efforts to facilitate attainment of the new, 8-hour ozone standard under CAA through SIP credit for selected categories of RE and EE programs and projects funded by the Clean Energy Program (CEP) of the NJ Board of Public Utilities (BPU). The project is significant because of the broad scope of the RE and EE programs and projects considered, including: (1) EE projects in new construction and retrofits of commercial and industrial (C&I) and residential buildings and schools (36,000 projects); (2) Energy Star® air-conditioning (50,000 units) and lighting (3.5 million units); (3) high-efficiency central air-conditioning (50,000 units) and ground-source heat pumps (1,000 units); and (4) solar photovoltaic (PV) projects (344 systems that total 2.5 MW).<sup>15</sup>

## **1.3 New Jersey Clean Energy Program**

The current NJ CEP began in 2001. It is funded by a “societal benefits charge” of more than \$100 million annually,<sup>16</sup> and includes a wide range of RE and EE programs and projects across

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<sup>12</sup> U.S. Environmental Protection Agency, *Green Book for Nonattainment Areas*. See <http://www.epa.gov/oar/oaqps/greenbk/>. Figures are from the October 5, 2005 update.

<sup>13</sup> These organizations include the National Association of State Energy Officials, the Environmental Council of the States, and the Global Environment & Technology Foundation.

<sup>14</sup> DOE fact sheet, “Integration Pilots: Improving Air Quality through Energy Efficiency and Renewable Energy Technologies,” 2004.

<sup>15</sup> See *infra*.

<sup>16</sup> Actual program expenditures were \$100 million in 2002, \$98 million in 2003, and \$108 million in 2004. Funding increased to \$140 million for 2004 and 2005 and is expected to increase to \$235 million by 2008.

the state. New Jersey is one of nearly 20 states that fund energy incentive programs under a systems benefit charge. The New Jersey “societal benefits charge” is about 3 mills/kWh, of which NJ CEP receives about 1 mill/kWh.<sup>17</sup> Growth in electricity savings<sup>18</sup> has increased 70% from 2002 to 2003 and 14% from 2003 to 2004, to outpace growth in expenditures. Because these RE and EE improvements are long lasting, New Jersey will see a cumulative benefit, as measures implemented in previous years continue to save or generate energy.

The project team focused on programs and projects completed under the NJ CEP in 2002, 2003, and 2004 in the following specific categories:

### **1.3.1 Residential Energy Efficiency**

- *Comfort Partners Low-Income Customers Program* – This program improves EE in the homes of low-income customers and includes a pilot program, implemented in 2004, for weatherizing the homes of senior citizens. Projects can include a wide range of EE measures such as lighting, appliances, insulation, and duct sealing and repair. Program expenditures were \$14.3 million in 2004. From 2002 through 2004, the program made improvements in more than 19,000 homes.
- *NJ Energy Star Homes* – This program works with residential builders to ensure that new homes are built to New Jersey Energy Star® standards, which exceed the standards of the national Energy Star program. Homes must use at least 30% less energy than homes built to the model national energy code and must be located in a “smart growth” area. Nearly 13,000 such homes were built between 2002 and 2004; in 2004, qualified homes represented 16% of all new homes in New Jersey. Program expenditures were \$21.7 million in 2004.
- *Cool Advantage and Warm Advantage* – This program focuses on energy-efficient cooling and heating equipment. Program expenditures were \$15.6 million in 2004. Between 2002 and 2004, the program led to the installation of more than 50,000 high-efficiency central air conditioners and more than 1,000 high-efficiency heat pumps.<sup>19</sup>
- *New Jersey for Energy Star* – This program promotes the use of Energy Star appliances and other products. The largest component of this program promotes compact fluorescent lights (CFLs) and other efficient residential lighting fixtures; more than 3.5 million units have been sold (commercial lighting is a separate program). Another element of this program provides rebates for high-efficiency room air conditioners; nearly 50,000 units were sold through 2004. In addition, New Jersey added a new component to this program in 2004 that promotes energy-efficient clothes washers. Lighting represented 97.8% of the electricity savings from 2004 projects in this category. In 2004, program expenditures totaled \$8.4 million.

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<sup>17</sup> See Atlantic City Electric tariff, effective July 1, 2005. The benefits charge may vary from year to year, according to the NJ CEP funding levels set by the NJ BPU.

<sup>18</sup> The program also implements several measures that can reduce natural gas demand and emissions. However, since our analysis focuses only on electricity savings, we have avoided use of the term *energy savings* to clarify that our analysis does not include natural gas savings.

<sup>19</sup> The program also funds furnaces and water heaters. These programs provide natural gas savings rather than electricity savings and are not included in our analysis.

### 1.3.2 Commercial and Industrial Energy Efficiency

*New Jersey SmartStart Buildings* – This program includes all C&I EE programs, grouped into three categories: (1) C&I new construction (\$3.9 million in 2004), (2) C&I retrofits (\$22.7 million in 2004), and (3) new school construction and retrofits (\$3.1 million in 2004). Measures may include lighting, motors, traffic signals, heat pumps, chillers, variable frequency drives, and other improvements. This program conducted more than 17,000 projects between 2002 and 2004.

### 1.3.3 Renewable Energy

*Customer On-Site Renewable Energy* (CORE) is the only RE program in New Jersey that has achieved energy generation to date. The project team's analysis focused on the PV component of this program. Though other renewable technologies such as wind and biogas have been installed, available data are insufficient for the project team to determine the resulting generation or emission reductions. Three hundred forty-four PV systems were installed under the program from mid-2003 through 2004, with an aggregate capacity of 2.5 MW.<sup>20</sup> This capacity represents five to six acres of PV panels.

### 1.3.4 New Jersey NO<sub>x</sub> Cap-and-Trade Program

Pursuant to the 1990 Amendments to CAA, EPA issued the NO<sub>x</sub> SIP Call, which required certain states to issue regulations that impose limits (a cap) on NO<sub>x</sub> emissions. The regulations also established a NO<sub>x</sub> emissions trading program to, among other things, reduce the cost of implementation to electric utilities.

In response to the NO<sub>x</sub> SIP Call, New Jersey issued NO<sub>x</sub> budget regulations<sup>21</sup> that included several components, such as an incentive reserve for RE and EE.<sup>22</sup> The New Jersey Department of Environmental Protection (NJ DEP) has incorporated the total emissions cap under its NO<sub>x</sub> budget regulations into its attainment demonstration for the 1-hour ozone standard.

The New Jersey incentive reserve set aside 410 NO<sub>x</sub> allowances that could be claimed by customers who saved electricity and owners and operators of RE projects. These incentive allowances can be traded or sold as an inducement to encourage RE and EE measures.<sup>23</sup> A project owner or energy customer can also “retire” such allowances, which will reduce the total emissions cap and help the state attain the ozone standard.

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<sup>20</sup> See Appendix 2 for a complete list of CORE projects during this period.

<sup>21</sup> NJAC 7:27-31 et seq.

<sup>22</sup> NJAC 7:27-31.8.

<sup>23</sup> Art Diem and Debra Jacobson, *Options for New Jersey to Obtain and Retire Allowances in Order to Obtain SIP Credit for Energy Efficiency and Renewable Energy Measures*, April 14, 2005, p. 4. Since its inception, the EERE incentive allowance pool has been undersubscribed in New Jersey, and the owners and operators of most of the projects subsidized through the NJ CEP have not yet applied for allowances under the Incentive Reserve. One of the major reasons for the limited use of the reserve appears to be that most small individual projects, such as small PV arrays and small EE projects, are not large enough to meet eligibility requirements for allowances on their own, and only one company has effectively pursued aggregation of projects to overcome this hurdle. Most projects involve emission reductions far below one ton, and allowances are only granted in one-ton increments. Discussion with Tom McNevin, NJ DEP, May 2005.

Under EPA's Clean Air Interstate Rule (CAIR), issued in the spring of 2005, NJ DEP is required to issue new NO<sub>x</sub> cap-and-trade regulations to replace its NO<sub>x</sub> SIP Call regulations for electric generating units.<sup>24</sup> NJ DEP has not yet developed these new regulations, which will govern NO<sub>x</sub> emission trading in New Jersey for the 2009 ozone season and thereafter. Therefore, the state has not yet announced its plans for allowance allocation under the new rules, including any decision on the continuation of its RE/EE incentive allowance.

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<sup>24</sup> 70 Fed. Reg. 25290 (May 12, 2005).

## **2.0 Energy Savings and Emissions Reduction Quantification Methodology**

### **2.1 Energy Efficiency**

The project team refined and expanded methodologies that were developed by the NJ CEP to estimate NO<sub>x</sub> emission reductions during the summer ozone season that result from measures implemented under the NJ CEP. This methodology:

1. Calculates the annual electricity savings resulting from the energy efficiency measures.
2. Estimates the electricity savings during the summer ozone season.
3. Calculates the NO<sub>x</sub> emission reductions during the summer ozone season.
4. Estimates the current electricity savings and ozone season NO<sub>x</sub> emission reductions of previously implemented projects.

The project team relied on calculations that were conducted by the NJ CEP for step 1; step 2 involved applying a summer season “allocation factor” to the estimate of annual electricity savings, and step 3 required that a “conversion factor” be applied to convert summer electricity savings into summer emission reductions. During this process, we identified step 4, and we employed a “degradation factor” to determine this quantity. Details of the analysis follow.

#### **2.1.1 Annual Electricity Savings**

The first step—the calculation of annual electricity savings—was based on the official protocols developed by the NJ CEP.<sup>25</sup> New Jersey has directed extensive effort into data tracking and estimating the electricity savings of various installed EE measures. For each type of technology, the protocols spell out the methodology used to estimate annual electricity savings. This approach is used in the program’s annual reports and in periodic cost-benefit analyses.

Thus, under the New Jersey energy saving protocols, electricity savings are not measured directly for each piece of equipment, but are calculated based on the characteristics of the installed technology. This approach greatly simplifies the data tracking and measurement procedure. The protocols compare a piece of equipment, such as a CFL, an Energy Star air conditioner, or a highly efficient industrial motor, to the average new model of that type and size. The protocols also take into account the typical hours of operation of that type of equipment at a specified facility (school, C&I, or residential). The savings stipulated by the protocols are based on almost 10 years of direct measurement.

For example, a CFL installed at a residential location is assumed to save 42 watts compared to a standard new light bulb,<sup>26</sup> and to provide these savings for 2.5 hours/day. Thus, each CFL is

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<sup>25</sup> New Jersey Clean Energy Program, *Protocols to Measure Resource Savings*, September 2004. See Appendix 3 for a more detailed explanation.

<sup>26</sup> This figure is based on a minimum electricity saving of 66% for Energy Star CFLs (as specified in the Energy Star labeling requirement), combined with NJ CEP assumptions about the typical wattage of incandescent bulbs replaced. The protocols indicate that this figure can be adjusted as the NJ CEP obtains better information.

assumed to save 38 kWh/year at the customer side, and 42 kWh of generation.<sup>27</sup> For the Energy Star homes program, home energy rating software is used to evaluate energy savings for each building constructed.<sup>28</sup>

The value of the New Jersey protocols is that they eliminate the need for tracking electricity savings for each piece of equipment and greatly simplify the energy savings estimation process. Such an approach would be unnecessarily burdensome in most cases. However, individual tracking may be a valid approach where there are only a few instances of a technology, or where the energy generation or savings of individual units are particularly large.

### **2.1.2 Summer Season Electricity Savings**

The second step—estimating summer ozone season electricity savings—is derived from “summer season allocation factors” specified by the protocols. In its annual reports, the NJ CEP uses the summer season allocation factors to determine the cost savings associated with various EE measures. This allocation is required because electricity tends to cost more in the summer. The summer season, as defined by the allocation factors, runs from May 1 through September 30, matching the ozone season. The project team used the allocation factors to identify NO<sub>x</sub> emission reductions during the summer ozone season when such factors were available.

In some cases the New Jersey protocols do not provide allocation factors, and the project team used other resources to identify the fraction of electricity savings that occurs during the summer season. In particular, the team employed allocation factors provided in the Emission Reduction Workbook developed for the Ozone Transport Commission (OTC).<sup>29</sup> Factors listed in the *OTC Emission Reduction Workbook* are well established and accepted by industry practitioners.

### **2.1.3 Baselines**

A baseline must be determined to establish electricity savings from EE programs. New Jersey officials, as well as our own project team, measured the electricity savings of the New Jersey EE programs against a “business-as-usual” baseline case that assumes the program was not implemented. For example, these baseline methodologies quantify the electricity savings benefit of a new high-efficiency air-conditioning system by comparing this system to the average new system of that size that conforms to current applicable codes and standards.

The New Jersey and pilot team methodologies are consistent with the standard methods for computing baselines for electricity savings. Such methods do not compare the new system to the previous system or to the average system, but rather to current standard technology. If, for example, a building consumes 4000 MWh/year less than before the energy-efficient equipment was installed, this amount is not used as the total savings.

Improved technology and standards dictate that some degree of energy savings improvement must be used to determine the baseline. Models used by the Energy Information Administration

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<sup>27</sup> Assumed transmission and distribution losses are 11%, according to the protocols.

<sup>28</sup> This approach will be required in other states, as it is required by the Energy Star homes program.

<sup>29</sup> The *OTC Emission Reduction Workbook 2.1*, Synapse Energy Economics, 2001. The allocation factors used for the NJ CEP’s cost-benefit analysis could not be directly employed in certain cases. However, they did confirm the accuracy of other resources, such as the *OTC Emission Reduction Workbook*.

and other energy experts assume that old equipment will wear out and be replaced by newer and more efficient equipment. Under these models, the installation of a typical new system is considered business as usual and not surplus energy savings, even if the new system results in some savings from the previous levels of electricity consumption. Some degree of improvement is already incorporated into projections used to develop SIPs.

A second component of the baseline determination involves identifying the impact of the electricity savings. If New Jersey did not implement its EE programs, additional electricity generation would be necessary to meet the increased load. Therefore, the type of technology that would have been used to meet this additional load needs to be projected. As recommended by EPA, the pilot team looked at the direct and immediate impact on fossil fuel plants.<sup>30</sup>

**Modified Excerpts from  
New Jersey Clean Energy Program Protocols to Measure Resource Savings  
Basic Methodology**

Electric Demand Savings =  $\Delta kW = kW_{\text{baseline}} - kW_{\text{energy efficient measure}}$

Electric Energy Savings =  $\Delta kW \times EFLH$

EFLH = Equivalent Full Load Hours of operation for the installed measure.

Electric Peak Coincident Demand Savings =  $\Delta kW \times \text{Coincidence Factor}$

Electric Loss Factor:

The electric loss factor applied to savings at the customer meter is 1.11 for both energy and demand. The electric system loss factor was developed to be applicable to statewide programs. Therefore, New Jersey used average system losses at the margin, based on PJM grid data (refers to the PJM Interconnection region, which includes New Jersey, Pennsylvania, Maryland, and neighboring states). This approach reflects a mix of losses that occur relative to delivery at various voltage levels. The 1.11 factor used for both energy and capacity is a weighted average loss factor and was adopted by consensus.

**Example: Central Air Conditioner**

Energy Impact (kWh) =  $CAPY/1000 \times (1/SEER_b - (1/SEER_q \times (1-ESF))) \times EFLH$

CAPY = Cooling capacity (output) of system

SEER<sub>b</sub> = The Seasonal Energy Efficiency Ratio of the Baseline Unit (set at 10).

SEER<sub>q</sub> = The Seasonal Energy Efficiency Ratio of the qualifying unit installed. These data are obtained from the application form based on the model number.

ESF = The Energy Sizing Factor or the assumed saving that results from proper sizing and installation (set at 17%).

EFLH = Equivalent Full Load Hours of operation for the installed measure (set at 600 hours for cooling).

Note: This text is based on the September 2004 New Jersey Protocol document and has been modified for illustrative purposes. A complete detailed list of the New Jersey energy-saving protocols may be found in Appendix 3 and at [www.njcleanenergy.com/media/Protocols.pdf](http://www.njcleanenergy.com/media/Protocols.pdf).

<sup>30</sup> A large and lasting EE program might defer the need for new power plants. However, this consideration is beyond the scope of the analysis required by EPA.



#### **2.1.4 Avoided Emissions Rate and Tons NO<sub>x</sub> Avoided**

The third step in the energy savings and emission reduction quantification methodology is to determine the NO<sub>x</sub> emission reductions that are achieved for a given electricity saving. Under the New Jersey NO<sub>x</sub> emission trading regulations, this conversion factor is specified as 1.5 lb for each megawatt-hour of energy savings (1.5 lb/MWh). Under the regulations, this conversion factor is fixed even if the actual emission reductions are greater than this amount.<sup>31</sup> Therefore, the actual avoided emissions need to meet or exceed the stipulated emission reductions.

#### **2.1.5 Degradation Factor**

When calculating the ongoing electricity savings from projects installed in previous years, the team decided that employing a degradation factor would be conservative and useful. The degradation factor accounts for some changes that may occur to an EE improvement: (1) equipment deteriorates over time, especially if maintenance is inadequate; (2) some equipment may be removed before the end of its useful life; and (3) a degradation factor can offer a substitute for estimating the lifetime effectiveness for specific types of efficiency measures.

Our calculations include a degradation factor of 15%/year for EE measures. For example, energy savings from 2004 measures are credited fully in 2005, but at 85% of their previous value in each successive year. To be conservative, a high figure is used as a placeholder until more precise calculations are conducted. Though using a single overall factor to all measures simplifies the calculation process, using different factors for different types of measures may be more accurate.<sup>32</sup>

### **2.2 Renewable Energy**

For RE generation,<sup>33</sup> the methodology for calculating the annual and summer ozone season avoided NO<sub>x</sub> emissions consists of three steps:

1. Calculate the annual and summer ozone season electricity generation of the renewable source.
2. Estimate the annual and summer ozone season NO<sub>x</sub> emission reductions.
3. Estimate the electricity generation and NO<sub>x</sub> reductions of previously implemented projects.

Thus, the emission reductions that result from RE are easier to quantify than those that result from EE. The baseline is simply the case in which the project was not implemented. The business as usual scenario assumes a negligible amount of RE and does not include projects that are implemented as a result of the NJ CEP. Therefore, all RE generation that is implemented through the NJ CEP is surplus and not included in the baseline.

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<sup>31</sup> N.J.A.C. 7:27-31.7(e)3.i.

<sup>32</sup> Examining varying degradation factors is beyond the scope of this initial pilot project.

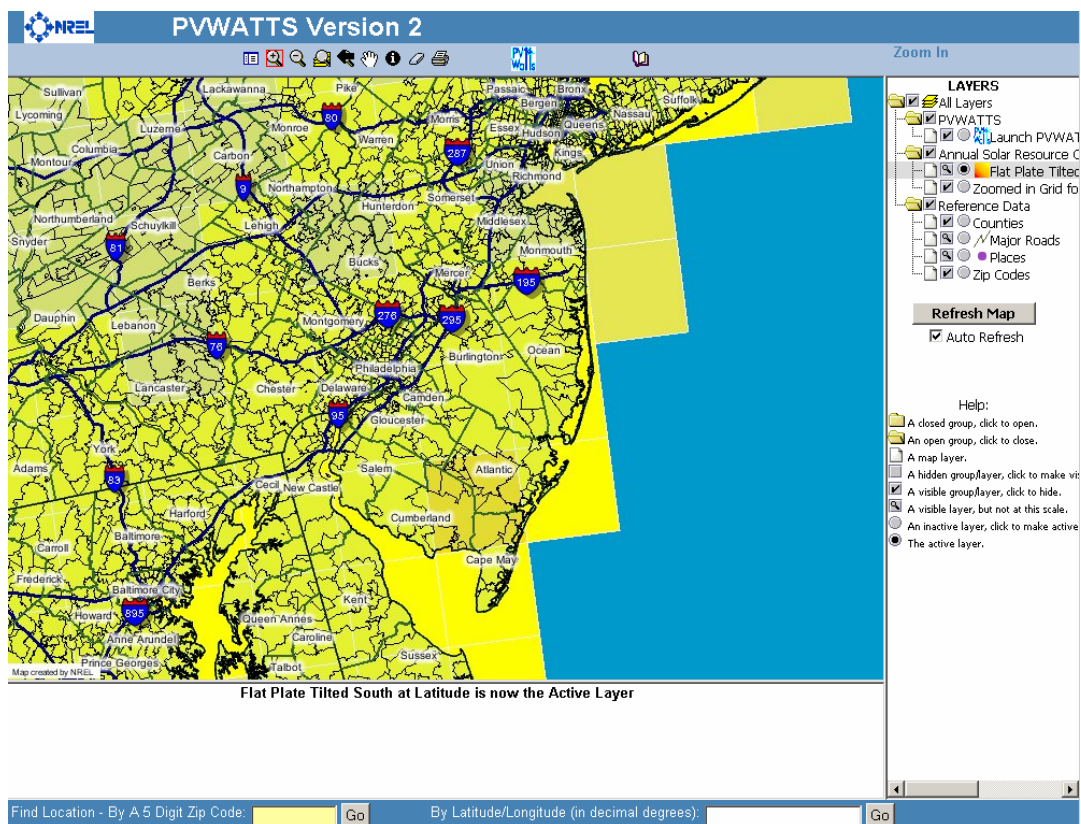
<sup>33</sup> The New Jersey regulations limit claims for incentive allowances to equipment that commenced operation in 1992 and thereafter and that generates electricity through one of the following “environmentally beneficial techniques”: (1) Generation through the burning of landfill gas or digester gas; (2) generation by a fuel cell; (3) generation using solar energy or wind power; or (4) generation through another environmentally beneficial technique approved by DEP. N.J.A.C. 7:27-31.8(c)

## 2.2.1 Annual and Summer Season Renewable Energy Generation

The first step is to calculate the annual and summer season electricity generation of the renewable source. The project team employed standard methodologies to estimate annual and summer season energy generation from PV projects based on the rated installed capacity.

The annual and summer season electricity generation for the 344 completed solar projects supported by the CORE program was calculated with the PVWATTS model (see Figure 1),<sup>34</sup> which was developed by NREL. NREL developed this model to provide a calculator for estimating the monthly generation of specified PV units on a per-kilowatt basis of installed capacity. With this tool, annual and monthly generation are provided simultaneously, so identification of annual and summer season energy production can be considered in a single step. The calculation is based on measurements of incident solar radiation recorded at observation stations in all 50 states.

### PV Watts



PVWATTS calculates electrical energy produced by a grid-connected photovoltaic (PV) system. Researchers at the National Renewable Energy Laboratory developed PVWATTS to permit non-experts to quickly obtain performance estimates for grid-connected PV systems within the United States and its territories. The grid cells indicate solar resource in kWh/m<sup>2</sup>/day.

**Figure 1. PVWATTS model**

<sup>34</sup> PVWATTS program version 2, NREL. <http://mapserve1.nrel.gov/website/PVWATTS/SLITE/viewer.htm>.

Because New Jersey is relatively small on a geographic scale (compared to Florida or California), the project team used a representative factor based on examination of three areas across the state to apply the PVWATTS model to New Jersey. The PV systems were grouped into 21 categories according to orientation and inclination. For example, the largest group (by capacity) consisted of systems that are oriented generally southward ( $160^{\circ}$ – $220^{\circ}$ ) at a tilt of  $30^{\circ}$ – $39^{\circ}$ . This group was modeled as orientation of  $180^{\circ}$  (south) and an inclination of  $35^{\circ}$ . The second-largest group consisted of systems with an inclination less than  $10^{\circ}$ ; these were modeled as flat-roof systems (which, in fact, most were).<sup>35</sup>

We calculated an average annual generation rate of 1,191 kWh/kW of installed capacity for the New Jersey solar PV projects.<sup>36</sup> The generation rate for the five-month ozone season is 597 kWh/kW of installed capacity. The total annual generation from the solar electric capacity of 2,521 kW is 3,003 MWh and the ozone season generation is 1,505 MWh.

### **2.2.2 Avoided Emissions Rate and Tons NO<sub>x</sub> Avoided**

A solar electric system produces no direct emissions. Moreover, solar electric displaces emissions from fossil fuel generating sources such as natural gas or coal-fired generation. As with EE measures, the New Jersey NO<sub>x</sub> regulations stipulate the allocation of incentive reserve allowances at a rate of 1.5 lb/MWh. This rate is applied to all nonemitting RE systems.

### **2.2.3 Degradation Factor**

Similar to EE, when calculating the ongoing renewable generation from previous years, the team decided that a degradation factor should be applied. The actual deterioration of solar panels can be quite small: well-maintained systems may experience output declines of less than 1%/year. However, systems that are not well maintained may be shaded, soiled, or have inverter failures or other problems. For this analysis, we used a degradation factor of 5%/year for solar PV systems. As with EE, this is a conservative factor that accounts for deterioration and system failures, and obviates the need for a fixed system lifetime.

A degradation factor of 5%/year implies that, by the end of 2012, the systems installed in 2004 will be, on average, at two-thirds of their original capacity. Some systems will have failed or been removed, but many will still be operating at almost their original capacity. NJ CEP conducts quality assurance tests through a random routine inspection of 10% of the larger (10 kW or greater) systems by comparing the estimated energy production with the inverter display. This sampling is conducted as part of the state's Solar Renewable Energy Certificate (SREC) trading system. These data could be used in the future to more precisely estimate the actual degradation factor. These refined estimates might provide the basis for a lower degradation factor.

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<sup>35</sup> For variations and the uncertainties associated with the weather data and the model used to model the PV performance, future months and years may be encountered where the actual PV performance is less than or greater than the values shown in the table. The variations may be as much as 40% for individual months and up to 20% for individual years. Compared to long-term performance over many years, the values in the table are accurate to within 10%–12%. The model also assumes a standard combined default factor of 0.77 for inefficiencies in conversions from DC power to AC power.

<sup>36</sup> The category with the highest annual generation included south-facing systems of  $30^{\circ}$ – $39^{\circ}$  inclination; these were deemed to have an annual generation of 1,263 kWh/DC kW.

## 3.0 Analysis and Results

### 3.1 Energy Efficiency

Our findings indicate that the efficiency measures installed pursuant to the NJ CEP in calendar years 2002, 2003, and 2004 should result in electricity savings for the summer of 2005 of approximately 320,000 MWh. Using the conversion factor specified in the New Jersey emissions trading regulations of 1.5 lb/MWh, this electricity saving translates into emission reductions of 240 tons of NO<sub>x</sub>.

### 3.2 Renewable Energy

Our analysis indicates that the solar electric projects installed under the CORE program in 2003 and 2004 generated 1,505 MWh during the summer ozone season of 2005. Based on the stipulated conversion factor in the New Jersey regulations, this generation accounted for emission reductions of approximately 1.13 tons of NO<sub>x</sub> during the 2005 summer ozone season.<sup>37</sup>

### 3.3 Summary Analysis

Table 1 illustrates the electricity savings, renewable generation, and avoided NO<sub>x</sub> emissions for the 2005 ozone season. It includes the savings from measures implemented in 2002 through 2004 with a 15% annual degradation factor for EE and a 5% annual degradation factor for RE.

**Table 1. Summary of 2005 Energy Savings, RE Generation, and Avoided NO<sub>x</sub> Emissions**

	2005 Summer MWh	2005 Summer NO <sub>x</sub> (tons)
Residential HVAC		
Central Air-Conditioning	38,457	28.84
Heat Pumps	407	0.31
Residential New Construction	4,715	3.54
Room Air-Conditioning	2,594	1.95
Lighting	63,464	47.60
Clothes Washers	276	0.21
Comfort Partners	6,733	5.05
C&I New Construction	62,794	47.10
C&I Retrofit	136,034	102.03
New School Construction and Retrofit	6,019	4.51
Combined Heat & Power	N/A	N/A
<b>Total Energy Efficiency</b>	<b>321,493</b>	<b>241</b>
Renewable Energy		
Solar Electric	1,505	1.13
Wind	TBD*	TBD*
Fuel Cells	TBD*	TBD*
Landfill Gas	TBD*	TBD*
<b>Total Renewable Energy</b>	<b>1,505</b>	<b>1.13</b>
<b>TOTAL</b>	<b>322,998</b>	<b>242</b>

\* See discussion of analytical issues and data gaps on pages 27–31, *infra*.

<sup>37</sup> If a power plant dispatch study were conducted, the actual displacement of NO<sub>x</sub> emissions might be calculated at a higher rate.

Although we have stated avoided emissions in tons per summer ozone season, SIP submissions to EPA to implement the ozone standard generally present NO<sub>x</sub> emissions avoided in tons/day. The 242 tons is equivalent to 1.6 tons/day.<sup>38</sup>

### 3.4 Preliminary Projection of NO<sub>x</sub> Emission Reductions from 2007 through 2012

If NJ DEP includes NO<sub>x</sub> emission reductions that result from the NJ CEP in its SIP for the 8-hour ozone standard, the agency will be required to project such reductions for the summer ozone season for the period 2007 through 2009 to demonstrate attainment of the ozone standard in 2010. The project team has not conducted a detailed analysis of the projected emission reductions for this period. However, we have developed preliminary projections based on the methodology and analysis conducted to date. We used the following assumptions to estimate NO<sub>x</sub> emission reductions for the summer ozone seasons from 2007 through 2012<sup>39</sup>:

- The determination of the baseline for this analysis was limited only to the specific NJ CEP programs that were covered in our analysis of emission reductions for the 2005 ozone season.<sup>40</sup>
- Estimates provided by the NJ CEP for future years project a growth of 20%/year for EE programs and 40%/year for RE programs. These projections are based on a New Jersey goal of a 10% increase in energy savings per dollar invested and annual increases in funding of approximately 10% for EE and 30% for RE.<sup>41</sup>
- The fraction of summer electricity savings remains at 46.38% of annual savings, and the fraction of summer PV generation remains at 50.13% of annual PV generation.
- The actual avoided emissions rate is 1.85 lb/MWh in 2004 and is projected to be 1.65 lb/MWh in 2005 and 2006, 1.24 lb/MWh in 2007, and 0.97 lb/MWh in 2008. This rate is estimated to decrease by 5%/year after 2008; the credited value will be the lesser of the actual rate or the stipulated rate of 1.5 lb/MWh.<sup>42</sup> The annual degradation factor is 15% for EE and 5% for RE, which reflects the relatively short lifetimes of many EE measures such as lighting, which accounts for a significant fraction of savings; and renovation or remodeling may also reduce EE measures.

To illustrate the sensitivity of our assumptions, four alternative scenarios are presented for comparison:

**Base Case Scenario:** Table 2 summarizes avoided NO<sub>x</sub> emissions under the assumptions presented earlier:

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<sup>38</sup> Total emission reductions during the summer ozone season in tons can be converted into tons/day by dividing by 153 (the number of days in the summer season).

<sup>39</sup> Although EPA is expected to require data for 2007 to 2009 only, the project team has provided projected scenarios through 2012 for informational purposes.

<sup>40</sup> See pp. 2–3, *supra*.

<sup>41</sup> The EE budget grows 43% over 2004 to 2008, and the RE budget grows 129% over that time. Program effectiveness per dollar has increased by more than 10% from 2002 to 2004.

<sup>42</sup> Estimated rates for 2004 to 2008 were provided by NJ DEP. These emission rates represent the generation-weighted average emissions rate for all NO<sub>x</sub> budget units in New Jersey; that is, all fossil fuel units greater than 15 MW. An analysis for 2009 may be necessary for SIP crediting, and may need to account for the impacts of CAIR.

**Table 2. Avoided NO<sub>x</sub> Emissions**

Year	Summer Electricity Savings (MWh)	Credited NO <sub>x</sub> Rate (lb/MWh)	Credited NO <sub>x</sub> Emissions (tons)
2005	322,999	1.50	242
2006	459,635	1.50	345
2007	613,387	1.24	380
2008	789,413	0.97	383
2009	993,723	0.92	458
2010	1,233,412	0.88	540
2011	1,516,942	0.83	631
2012	1,854,483	0.79	733

**First Alternative Scenario – Low Growth:** Table 3 shows the avoided emissions with the program electricity savings growing only as fast as the program budget, rather than the higher rates assumed in the base case scenario. All other assumptions are the same as the base case.

**Table 3. Avoided Emissions with Program Electricity Savings Level with Program Budget**

Year	Summer Electricity Savings (MWh)	Credited NO <sub>x</sub> Rate (lb/MWh)	Credited NO <sub>x</sub> Emissions (tons)
2005	322,999	1.50	242
2006	444,249	1.50	333
2007	564,845	1.24	350
2008	686,788	0.97	333
2009	812,013	0.92	374
2010	942,436	0.88	413
2011	1,080,005	0.83	449
2012	1,226,749	0.79	485

This scenario illustrates the impact of the state's goal for the NJ CEP of improving energy saved per dollar invested by 10%/year. If that goal is not met, and energy savings grow only as fast as the program budget, avoided emissions in 2012 are one-third less than they are in the base case.

**Second Alternative Scenario – Sustained Measures:** Table 4 shows the avoided emissions with the degradation factors set at 5%/year for EE and 2.5%/year for RE instead of 15% and 5%, respectively. All other assumptions are the same as the base case.

**Table 4. Avoided Emissions with Degradation Factors at 5% per Year**

Year	Summer Electricity Savings (MWh)	Credited NO <sub>x</sub> Rate (lb/MWh)	Credited NO <sub>x</sub> Emissions (tons)
2005	350,334	1.50	263
2006	517,790	1.50	388
2007	714,334	1.24	443
2008	946,181	0.97	459
2009	1,220,841	0.92	563
2010	1,547,405	0.88	677
2011	1,936,894	0.83	805
2012	2,402,698	0.79	949

This scenario shows avoided emissions in 2012 that are nearly one-third higher than those in the base case. The lower degradation factors are reasonable (and in fact conservative) for systems that are properly maintained and monitored.<sup>43</sup> NJ CEP can ensure a higher level of avoided emissions in future years by demonstrating the continued performance of previously implemented RE/EE measures. C&I facilities that benefit from EE improvements through NJ CEP should be encouraged to take steps to ensure the continued performance of their new systems.

**Third Alternative Scenario – Clean Grid:** Table 5 shows the avoided emissions with the actual avoided emissions rate falling by 10%/year instead of 5%/year after 2008. All other assumptions are the same as the base case.

**Table 5. Avoided Emissions with Actual Avoided Emissions Rate Falling by 10% per Year**

Year	Summer Electricity Savings (MWh)	Credited NO <sub>x</sub> Rate (lb/MWh)	Credited NO <sub>x</sub> Emissions (tons)
2005	322,999	1.50	242
2006	459,635	1.50	345
2007	613,387	1.24	380
2008	789,413	0.97	383
2009	993,723	0.87	434
2010	1,233,412	0.79	485
2011	1,516,942	0.71	536
2012	1,854,483	0.64	590

Expedited reductions in NO<sub>x</sub> emission rates from power plants would lower the amount of NO<sub>x</sub> avoided by RE and EE measures. However, many power plants have already implemented the most cost-effective pollution controls available and have less room for improvement. NJ DEP considers that the reduction in NO<sub>x</sub> emission rates will probably slow after 2008.

**Fourth Alternative Scenario – Full Renewable Energy:** Table 6 shows the impact of New Jersey meeting its RE goals by 2012. These goals are 300 MW of RE, including 90 MW of PV. The non-PV RE is assumed to be 50% wind and 50% biomass (landfill gas, possibly in fuel cells), with a wind capacity factor of 35%, a wind seasonal allocation factor of 40%, a biomass capacity factor of 75%, and a biomass seasonal allocation factor of 45%.<sup>44</sup> This case involves considerable speculation about the performance of wind and biomass systems.

If met, New Jersey's RE goal would lead to a significant reduction in emissions by 2012, primarily because of the non-PV RE component, which attains a larger capacity and a higher capacity factor than PV.

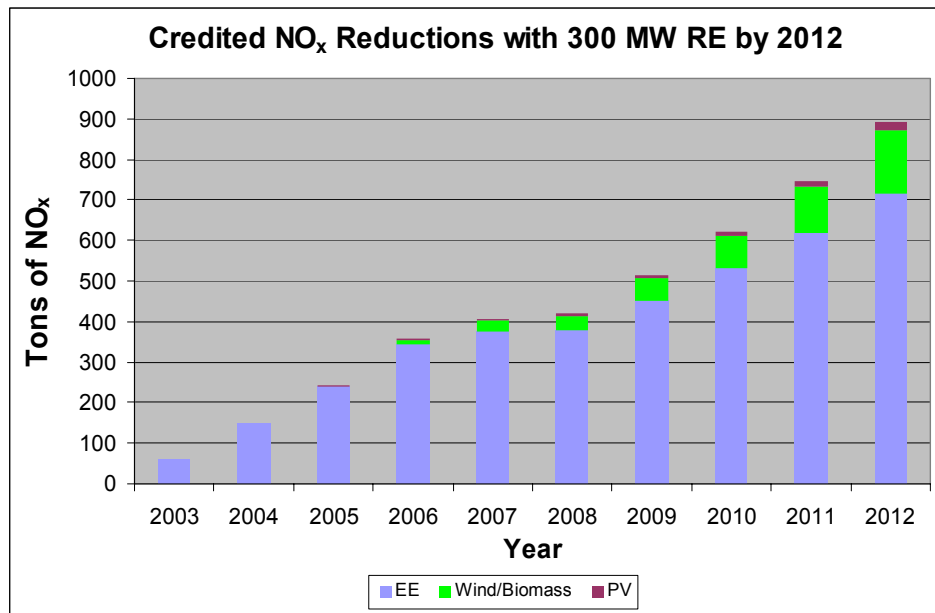
<sup>43</sup> See G. Kats, A. Rosenfeld, T. McIntosh, and S. McGaraghan, *Energy Efficiency as a Commodity: The Emergence of an Efficiency Secondary Market for Savings in Commercial Buildings*, Published in ACEEE 1997 Summer Study, Part I, Panel 2.

<sup>44</sup> Only the avoided electricity generation emissions, not the direct emissions, are considered for biomass. This would be the case when the biomass emissions equal the avoided flaring emissions.

**Table 6. Impact of New Jersey Meeting Its Renewable Goals by 2012**

Year	Summer Electricity Savings (MWh)	Credited NO <sub>x</sub> Rate (lb/MWh)	Credited NO <sub>x</sub> Emissions (tons)
2005	322,999	1.50	242
2006	477,500	1.50	358
2007	655,576	1.24	406
2008	865,085	0.97	420
2009	1,115,850	0.92	514
2010	1,420,342	0.88	622
2011	1,794,610	0.83	746
2012	2,259,530	0.79	893

Figure 2 shows the NO<sub>x</sub> emission reductions achieved by each component of the NJ CEP: EE, PV systems, and other RE.

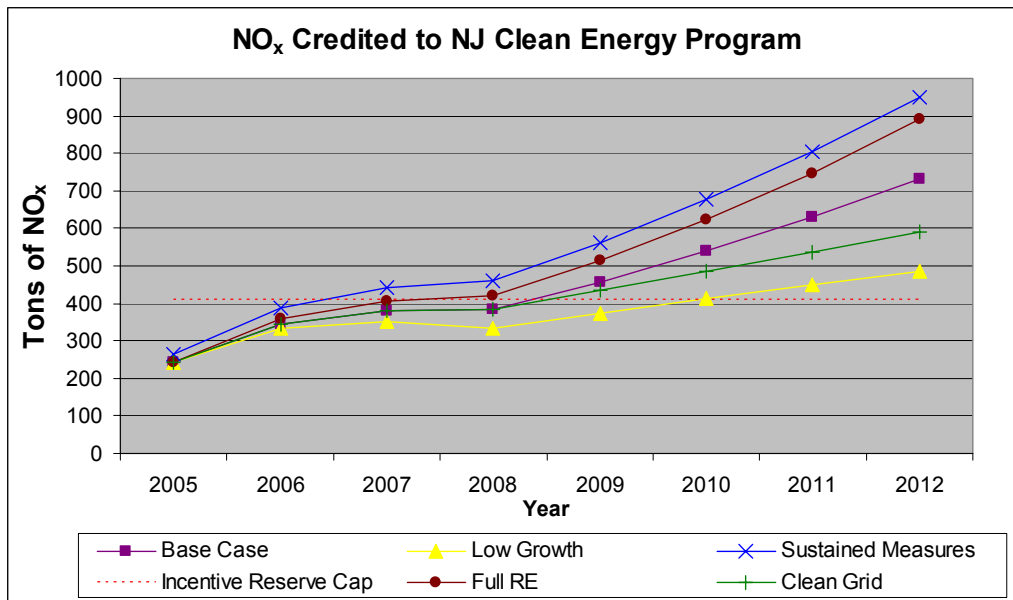


**Figure 2. Credited NO<sub>x</sub> Reductions with 300 MW RE by 2012**

**Summary of Scenarios:** Varying each of these assumptions leads to markedly different results. The projection of the avoided NO<sub>x</sub> emissions rate under each alternative assumption is particularly important. Because of these differences, NJ DEP should consider an analysis of the projected summer season NO<sub>x</sub> rate of dispatchable fossil fuel electric generation facilities. Also, demonstrating the sustained performance of previously implemented EERE measures and continued improvements in the cost effectiveness of the NJ CEP will be important.

Figure 3 illustrates NO<sub>x</sub> credited to NJ CEP:





**Figure 3. NO<sub>x</sub> Credited to NJ CEP**

A rapid decrease in the avoided NO<sub>x</sub> rate causes avoided emissions to level off or decline slightly from 2007 to 2008. In most scenarios, avoided emissions consistently approach or exceed 400 tons/year, and in some cases, they double that level. When non-BPU claimants to allowances are included,<sup>45</sup> the current Incentive Allowance Reserve of 410 tons is likely to be oversubscribed in most years of the program.<sup>46</sup> One possible option available to NJ DEP is to transfer unused allowances from the Growth/New Source Reserve to the Incentive Allowance Reserve.<sup>47</sup> NJ DEP has indicated that the Growth/New Source Reserve is unlikely to be fully utilized.

<sup>45</sup> The DEP issued 47 incentive allowances to private parties in 2004.

<sup>46</sup> The limit of 410 tons per season is set forth in New Jersey Administrative Code, Title 7, Chapter 27, Subchapter 31.7, Part(d)ii. See [www.state.nj.us/dep/aqm/Sub31v2004-04-05.htm](http://www.state.nj.us/dep/aqm/Sub31v2004-04-05.htm).

<sup>47</sup> The New Jersey NO<sub>x</sub> budget regulations allocate 820 allowances into this reserve from 2004 to 2008. NJAC 7:27-31.7(d)(1). New Jersey has not yet issued regulations to implement the EPA's CAIR, and New Jersey's CAIR rule will determine the size of any new source allocations for 2009 and thereafter.

## 4.0 Policy Issues

### 4.1 Interface between State Implementation Planning Process and State Cap-and-Trade Regulations

One of the major challenges of this pilot project was to develop an approach to ensure that RE and EE programs result in real reductions in emissions of NO<sub>x</sub>, a pollutant that is subject to emissions trading (cap-and-trade) regulations in New Jersey and most eastern states. The SIP process under CAA Section 110 is the mechanism to account for emission reductions.<sup>48</sup> Under EPA's 2004 guidance, states can receive emission reduction credit in their SIPs for RE and EE measures that reduce NO<sub>x</sub> emissions and help achieve the 8-hour ozone health standard, under specified circumstances.<sup>49</sup>

Currently, states in the eastern United States have caps on NO<sub>x</sub> emissions from electric generating units (EGUs) through regulations that implement EPA's NO<sub>x</sub> SIP Call. Beginning in 2009, these caps in 28 states and the District of Columbia will be governed by new regulations that are being developed by the states that implement EPA's new CAIR.<sup>50</sup> As a result, credit for RE and EE projects must be provided in a way that avoids double counting. According to EPA's Guidance, the states will need to ensure that the emissions trading cap for NO<sub>x</sub> and the number of allowances allocated to fossil-fuel generators are reduced commensurate with the level of emission reductions that result from EERE projects and programs.

This can be accomplished in one of two ways:

- **Baseline Approach** – Incorporates the estimated effect that the RE and EE programs have on emissions within the projected emissions inventory baseline and provides a corresponding decrease in the emissions cap. This decrease in the emissions cap to account for the RE and EE programs can be accomplished by issuing CAIR regulations that adjust the EPA-established state cap at the outset through an attainment reserve, public health reserve, or similar mechanism.
- **Control Measures Approach** – Incorporates emission reductions from individual control measures such as a regional wind purchase or solar programs in schools (or as part of a voluntary bundle of control measures), and provides a corresponding decrease in the emissions cap. The decrease in the cap can be accomplished by retiring allowances that have been allocated to RE and EE projects through a set-aside or output-based regulations issued under the state's NO<sub>x</sub> budget or CAIR regulations.

According to guidance issued by EPA in August 2004, both approaches are acceptable.<sup>51</sup> Of course, under any approach, the state's SIP will require approval by the relevant EPA Regional Office (Region II with respect to New Jersey).

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<sup>48</sup> 42 U.S.C. 7410 (2005).

<sup>49</sup> EPA SIP Guidance.

<sup>50</sup> 70 Fed. Reg. 25162 (May 12, 2005).

<sup>51</sup> EPA SIP Guidance, pp. 13–14.

In other words, to achieve SIP credit under either approach, the state must either omit a certain fraction of allowances from distribution (thereby lowering the NO<sub>x</sub> emissions cap at the outset) or require the retirement of any such allowances allocated to EERE owners and operators. Otherwise, the emissions would be allowed within the trading program and could be double counted.<sup>52</sup>

The justification for EPA's approach is that EERE activities are unlikely to result in emission reductions of a capped pollutant, particularly in the near term, unless the state lowers the cap directly or retires allowances (the authorization to emit a ton of NO<sub>x</sub>) to account for the reduction in demand from fossil fuel generators caused by the EERE measures. According to EPA, the cap-and-trade program allows the same emissions from fossil fuel-fired generation, no matter how much generation these sources are called upon to meet demand. EPA is concerned that fossil fuel generators are likely to take the allowances made available when coal, natural gas, or oil generation is displaced by RE and EE measures and either use such allowances or sell them to other generators. This results in the continued emissions of NO<sub>x</sub> at the capped amount and the failure to provide surplus emission reductions.

As EPA states in its Guidance:

Cap and trade programs are enforced through the issuance of a limited number of allowances (authorizations to emit) that are equal to the emissions cap. Through trading and banking of these allowances, individual sources can vary their emissions as long as the aggregate emissions for all sources do not exceed the allowances issued. By limiting total mass emissions for the category of sources, cap and trade programs automatically account for any action that reduces emissions, including energy efficiency and renewable energy.<sup>53</sup>

Under the base case scenario for the NJ CEP, NJ DEP could lower the NO<sub>x</sub> emissions cap by 520 allowances on average for the summer ozone season from 2007 through 2012, which is equivalent to an average emission reduction of 3.4 tons of NO<sub>x</sub> per summer day. Because NJ CEP will increase the market for RE and EE and the integration pilot will raise the visibility of the Incentive Allowance Reserve, private parties will probably claim additional allowances.

## **4.2 Claims for New Jersey Incentive Allowances**

Under its current emissions trading regulations, New Jersey has included a set-aside of NO<sub>x</sub> allowances for certain RE and EE activities.<sup>54</sup> This is called the "incentive allowance" pool and

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<sup>52</sup> Id., p. 18.

<sup>53</sup> Id., p. 9.

<sup>54</sup> Under the incentive allowance regulations, the following two categories of entities are specifically listed as eligible to submit an annual claim for allowances: (1) New Jersey electricity consumers who reduce electricity consumption by implementing an EE measure initiated in 1992 or thereafter (subject to certain additional conditions); and (2) owners and operators of equipment that commenced operation after 1992 that generates electricity through certain environmentally beneficial techniques defined as generation by burning of landfill gas or digester gas, fuel cell, solar energy or wind power, or equipment that generates electricity by another environmentally beneficial technique approved by the DEP. N.J. 7:27-31.8.

is distributed at the rate of 1.5 lb/MWh with a current cap of 410 allowances.<sup>55</sup> If the incentive allowance pool is oversubscribed, these allowances are distributed pro-rata.<sup>56</sup> Under current NO<sub>x</sub> budget regulations, unused allowances can be transferred from the Growth/New Source Reserve, thereby increasing the number of incentive allowances distributed. However, the adequacy of the post-2008 allowances for RE and EE will depend on the specifics of the NJ CAIR regulations, which have not yet been issued.

### 4.3 Developing SIP Control Measures that Meet EPA Requirements

If a state proceeds with a SIP to seek approval of individual control measures for RE and EE, it will need to demonstrate to EPA that its emission reductions will be surplus, quantifiable, enforceable, and permanent.<sup>57</sup>

#### 4.3.1 Surplus Requirement

EPA notes in its SIP Guidance that “the surplus requirement is especially important in areas subject to a cap and trade program.”<sup>58</sup> However, the Guidance emphasizes that:

One acceptable way of achieving additional emission reductions from energy efficiency and renewable energy measures in the presence of a cap and trade program is through the *retirement of allowances* commensurate to the emissions expected to be reduced by the energy efficiency measures. The retirement of allowances provides some level of assurance that the energy efficiency measures will achieve emission reductions that are *surplus* to the emission reductions under the cap and trade program.<sup>59</sup> (emphasis added)

As a result of this guidance, NJ BPU and DEP have worked together under this pilot project to plan an approach for retiring allowances that are obtained by BPU under the incentive allowance program. This should provide a key element to help meet the surplus requirement.

In addition, if emission reductions from RE and other measures are included in individual control measures, they cannot be included in the baseline emissions inventory for a SIP to meet the 8-hour ozone standard. This element is crucial to ensure that emission reductions are not double counted and that they are surplus and have not been otherwise relied on to meet air quality attainment requirements.

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The regulations do not directly authorize the issuance of allowances to an entity that aggregates allowances on behalf of energy-saving electric consumers or owners or operators of environmentally beneficial techniques. However, the regulatory history of the regulation, contained in the NO<sub>x</sub> Budget Rule Adoption Document (government response to comment 123), indicates that “the rules adopted herein do not preclude the submittal of a claim on behalf of the owner or operator of [a] project eligible for submitting a claim. Neither do the rules preclude aggregating several different projects into a single claim.”

In addition, a precedent has been established for the award of allowances from the incentive reserve to an energy services company named SYCOM on behalf of its clients who contracted for EE projects.

<sup>55</sup> N.J.A.C. 7:27–31.7(e).1. In 2004, applicants claimed 47 of the 410 incentive allowances (NJ DEP).

<sup>56</sup> N.J.A.C. 7:27–31.7(e)3.iv.

<sup>57</sup> EPA SIP Guidance, pp. 4–7.

<sup>58</sup> *Id.*, p. 5.

<sup>59</sup> *Id.*, p. 10.

#### 4.3.2 Quantifiable Requirement

Another key component of EPA's regulations and SIP Credit Guidance is a demonstration that the NO<sub>x</sub> emission reductions that result from the NJ CEP are quantifiable. During the course of the pilot project, EPA officials advised informally that this test might be simplified because of the stipulation of the New Jersey regulations that fossil fuel emissions are displaced by RE and EE at a rate of 1.5 lb/MWh. EPA officials have indicated that some basic analysis should be conducted to demonstrate that the avoided emissions associated with the displaced fossil fuel generation are no less than the presumed rate of 1.5 lb/MWh.

The project team evaluated several methodologies to support the quantifiable requirement and to demonstrate that the avoided emissions were in fact greater than 1.5 lb/MWh. The team determined that the best methodology available for the purposes of the pilot project was to estimate the generation-weighted average NO<sub>x</sub> rate of New Jersey fossil fuel plants. This methodology would provide a reasonable approximation of the marginal emissions rate without the time and expense of a complete grid system dispatch analysis.

The analysis included only facilities that were fossil fuel powered for their primary source of input energy, including those that burn coal, natural gas, and petroleum fuels. Under this generation-weighted approach, the estimated avoided emissions are driven by facilities that contribute the most generation to the system.

Initially the primary data source for this methodology was EPA's eGRID database 2002, which was last updated with emission rates from 2000.<sup>60</sup> However, the mix of fossil fuel generating facilities in New Jersey has changed significantly since 2000. As a result, the project team used more recent estimates, provided by NJ DEP, of NO<sub>x</sub> emission rates for 2003 to 2008.<sup>61</sup> These rates represent the generation-weighted average of NO<sub>x</sub> budget units in the state; they include all fossil fuel generating plants with a capacity greater than 15 MW. These and other methodologies are discussed in greater detail in Appendix 4.

Under the New Jersey regulations, RE generation uses the same 1.5 lb/MWh rate for avoided NO<sub>x</sub> emissions as EE. This rate is fully applicable for zero-emission renewable sources such as solar electric generation.<sup>62</sup>

#### 4.3.3 Enforceability Requirement

If a state pursues SIP credit for RE and EE projects as individual control measures, it must also meet the enforceability test under EPA's voluntary measures policy.<sup>63</sup> RE and EE measures

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<sup>60</sup> The project team initially relied on data from the U.S. Energy Information Administration and EPA (the Emissions & Generation Integrated Database or eGRID).

<sup>61</sup> Tom McNevin, Bureau Air Quality Planning, NJ DEP, personal communication, September 2005.

<sup>62</sup> In comparison, certain RE sources such as landfill gas systems not only produce electricity but also produce some NO<sub>x</sub> emissions of their own and reduce emissions that would be produced by the alternative disposal of that landfill gas (typically flaring). In such cases, the net avoided emissions—the emissions produced by the landfill gas engine minus the sum of 1.5 lb/MWh (for the avoided generation of fossil fuel-fired electricity and the emissions that would be produced from flaring the landfill gas) must be calculated.

<sup>63</sup> See EPA's, "Incorporating Voluntary and Emerging Measures in a SIP," September 2004 for the voluntary measures policy. Such EERE measures would need to meet all applicable requirements of the voluntary measures policy (hereinafter cited as Voluntary and Emerging Measures Policy). See [www.epa.gov/ttn/oarpg/tl/pgm.html](http://www.epa.gov/ttn/oarpg/tl/pgm.html).

typically result in emission reductions at fossil fuel generating plants located some distance from the RE or EE activities. Although such measures are not enforceable against the direct emitting sources, they are enforceable against the entities such as state and local governments that undertake such activities.<sup>64</sup>

If a SIP revision is approved under the voluntary measures policy, a state is responsible to ensure that the reductions credited in the SIP are made. The state would need to make an enforceable SIP commitment to monitor, assess, and report on the emission reductions that result from the voluntary measure, and remedy any shortfalls from forecasted emission reductions in a timely manner. For voluntary and emerging measures that cover stationary sources, a presumptive limit of 6% of the total reductions is needed to meet any requirements related to attainment or maintenance of the air quality standards or reasonable further progress or rate of progress, as described in the policy.<sup>65</sup> A separate limit of 3% applies to voluntary mobile source programs. Thus, there is a presumptive 9% limit on the inclusion of voluntary and emerging measures in a SIP, although a state may seek case-by-case EPA approval of a higher limit.<sup>66</sup>

Recently, EPA issued a new guidance document on incorporating bundled measures in a SIP,<sup>67</sup> which should facilitate efforts by states to meet the enforceability requirement with voluntary SIP control measures. As stated in EPA's transmittal memorandum to regional air directors:

The guidance supports the development of additional emissions reductions from innovative approaches by describing how States can identify individual voluntary and emerging measures and "bundle" them into a single SIP submission. The emissions reductions for each measure in the bundle would be quantified and, after applying an appropriate discount factor for uncertainty, the total reductions would be summed together in the SIP submission. After SIP approval, each individual measure would be implemented according to its schedule in the SIP. It is the performance of the entire bundle (the sum of emissions reductions from all the measures in the bundle) that is considered for SIP evaluation purposes, not the effectiveness of any individual measure.

In other words, by grouping a set of voluntary control measures into a bundle, the state minimizes the chance that it will experience a shortfall later when the effectiveness of the measures is evaluated. By averaging the contribution of multiple measures, overperformance of some measures will likely compensate for underperformance of others.

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<sup>64</sup> See EPA SIP Guidance, pp. 5–7.

<sup>65</sup> *Ibid.*

<sup>66</sup> EPA, Voluntary and Emerging Measures Policy, p. 9.

<sup>67</sup> Memorandum from Stephen D. Page, director, Office of Air Quality Planning and Standards, EPA, and Margo Tsirigotis Oge, director, Office of Transportation and Air Quality, EPA, to Air Division Directors, "Guidance on Incorporating Bundled Measures in a State Implementation Plan," August 16, 2005. See [www.epa.gov/ttn/oarpg/t1pgm.html](http://www.epa.gov/ttn/oarpg/t1pgm.html).

#### 4.3.4 Permanence Requirement

EPA's SIP Guidance requires that a control measure "should be permanent throughout the term for which the credit is granted unless it is replaced by another measure or the State demonstrates in a SIP revision that the emission reductions from the measure are no longer needed to meet applicable requirements." The guidance emphasizes that the emission reductions will qualify as meeting the permanence test even if the emission reductions change over time or vary from season to season.<sup>68</sup>

Thus, NO<sub>x</sub> emission reductions that result from the BPU's CEP will satisfy the permanence test even if the reductions from efficiency measures decline over time or the RE generation varies from one season to another. However, New Jersey will need to ensure that the estimated emission reductions are delivered.

One way states have sought to address the fact that the impact of emission reductions from RE and EE measures is often variable during the term of the SIP is through the bundled measures approach addressed earlier. Maryland incorporated this creative approach in its SIP revision to meet the 1-hour ozone standard,<sup>69</sup> and this example was showcased by EPA at its 2004 Air Innovations Conference.<sup>70</sup>

#### 4.4 The Purpose and Uses of Allowances

The initial purpose of the New Jersey incentive allowance for EE and EE (and similar NO<sub>x</sub> allowance set-asides adopted by six other states)<sup>71</sup> was to provide a financial incentive to entities that adopt such pollution prevention projects. Thus, issuance of such allowances to RE and EE developers was designed to offset the cost of installing such projects and spur increased use.

In the past few years, state officials have recognized that the reduction of the NO<sub>x</sub> emissions cap (either through a direct reduction at the outset or by retiring NO<sub>x</sub> allowances) is a prerequisite to SIP credit in a state with a NO<sub>x</sub> cap-and-trade program. As stated previously,<sup>72</sup> RE and EE activities are unlikely to result in emission reductions of a capped pollutant unless the state lowers the EPA-established cap directly or retires allowances to account for the reduction in demand from fossil fuel generators that results from the RE and EE measures.

During the pilot project, participants discussed their interest in ensuring that two goals—spurring increased EERE development and achieving improved air quality—could be accomplished. For example, an approach that balances both goals might allow applicants for NO<sub>x</sub> allowances to either sell or retire such allowances.

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<sup>68</sup> EPA SIP Guidance, p. 7.

<sup>69</sup> See 70 Fed. Reg. 24987 (May 12, 2005) for final EPA approval of the voluntary bundle and [www.mwcog.org/committee/committee/archives.asp?COMMITTEE\\_ID=14](http://www.mwcog.org/committee/committee/archives.asp?COMMITTEE_ID=14) (February 19, 2004) for the detailed SIP revisions, Chapter 7, pp. 77--81 and Appendix J, J-71-76.

<sup>70</sup> [www.epa.gov/ttnmain1/airinnovations/aiconf.2004.html](http://www.epa.gov/ttnmain1/airinnovations/aiconf.2004.html) Presentation by Brian Hug, Maryland Department of Environmental Protection.

<sup>71</sup> These states are Maryland, New York, Massachusetts, Indiana, Ohio, and Missouri.

<sup>72</sup> See p. 18, *infra*.

A recent presentation by Kevin Rackstraw of Clipper Wind Energy has underscored the monetary value in the Renewable Energy Credit (REC) market of NO<sub>x</sub> allowances awarded to RE generators under a well-structured allowance allocation program.<sup>73</sup> According to Mr. Rackstraw, this monetary value accrues in the REC market with the retirement of NO<sub>x</sub> allowances, and can greatly enhance financing opportunities.<sup>74</sup>

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<sup>73</sup> It is important to recognize the difference between the RECs and emission trading markets that involve NO<sub>x</sub> allowances. In essence, RECs and allowances are two separate trading currencies. However, energy marketers have begun to recognize that the value of a REC can be increased if the REC is sold in conjunction with an allowance that can be retired because this REC will then ensure emission reduction of the capped pollutant.

<sup>74</sup> See the Web site of the American Wind Energy Association for a copy of this presentation.  
[www.awea.org/seminars/past\\_events.html](http://www.awea.org/seminars/past_events.html).



## 5.0 Analytical Issues

### 5.1 Energy Efficiency

During this project, the team worked to resolve analytical challenges in a number of areas. These challenges included estimating the electricity savings, the summer season electricity savings, and the emission reductions.

In many cases, the reporting mechanisms established by the NJ CEP resolved important issues. In other cases, experts from NJ BPU and NJ DEP were able to clarify key points. However, the project team sometimes had to refine and expand the methodologies.

One of the major challenges was the estimation of summer season energy savings. This factor is essential because the current ozone regulations focus on NO<sub>x</sub> emissions during the summer ozone season.<sup>75</sup>

The seasonal allocation factors applied by the Clean Energy Protocols form a sound methodological tool and were applied by the project team, where available. The NJ CEP seasonal factors generally agree with the findings of other analyses, such as the *OTC Emission Reduction Workbook*. These allocation factors are particularly appropriate for consumer products and appliances such as light bulbs and clothes washers.

However, NJ CEP could not provide data on seasonal load profiles for every category of energy-saving measure considered by the project team. For example, the Clean Energy Protocols include “custom measures” as a catch-all category that encompasses any type of measure not detailed elsewhere. In such cases, the Clean Energy Protocols allocate savings evenly across the year. This specific set of seasonal allocation factors is acceptable but not preferable.<sup>76</sup> NJ CEP recognizes this limitation, noting that “[t]hese allocations may change [when] actual penetration numbers are available.”<sup>77</sup>

In addition, the annual and quarterly reports currently prepared by the NJ CEP do not provide sufficient detail on C&I EE improvements that are necessary to estimate summer season energy savings. The reports provide aggregated data on C&I electricity savings combined with information on the number, but not the size of electricity savings or of specific measures such as motors, chillers, or lighting controls. Unfortunately, many types of C&I measures have significantly different seasonal load profiles that have result in varying summer season electricity savings.

In this situation, the project team employed the *OTC Workbook* seasonal allocation factors specified for “Commercial Comprehensive New Construction Design.” This approach was selected because this category includes a range of efficiency measures. Based on this factor, we

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<sup>75</sup> EPA’s new regulations under CAIR, issued in May 2005, focus on both summer season and annual NO<sub>x</sub> emissions. 70 Fed. Reg. 25162.

<sup>76</sup> Because electricity use for most loads is either summer peaking (as for HVAC) or equal year-round (as for office computers), assuming equal year-round energy savings is unlikely to overstate summer energy savings.

<sup>77</sup> *Protocols to Measure Resource Savings*, Appendix 3, p. 27.

assumed that 43% of C&I energy savings occurred during the summer season. For some types of commercial measures, such as the 364 high-efficiency electrical chillers and heating, ventilation, and air-conditioning (HVAC) systems installed in 2004, summer season savings are expected to be much higher. For other types of commercial measures, such as the 358 motors installed, summer season savings could be slightly lower (the *OTC Workbook* suggests that industrial motors achieve 39% of their savings in the summer season).

NJ CEP has access to data on C&I energy savings by type of measure through the utilities.<sup>78</sup> In future years, the program will have the data readily available. NJ CEP could conduct an analysis to determine whether the project team's estimated allocation factors are reasonable. A significant overrepresentation or underrepresentation of measures with high seasonal variability, such as HVAC systems, could lead to revisions of the projected emission reductions.

Another area of uncertainty that the project team confronted was the definition of HVAC.” NJ CEP provided data on the number of units that were categorized as central air-conditioning or heat pumps, as well as the annual electricity savings that result from HVAC as a whole. However, NJ CEP did not provide the project team with information in its database on the relative size of these units, or on the summer season electricity savings for the heat pumps. These data are important because some heat pumps save electricity during the winter.

In an effort to address these information gaps, the project team applied the following assumptions:

- Each measure saved the same amount of energy per unit, so the fraction of electricity savings attributable to central air conditioning was the same as the fraction of units that were central air conditioners.<sup>79</sup>
- Half the heat pumps were air-source and half were ground-source (affects peak versus off-peak calculations).
- Each heat pump achieved half of its annual electricity savings in the summer.

Our analysis is not significantly affected by these assumptions because the number of central air conditioners was 50 times greater than the number of heat pumps.

Another analytical challenge arose because the New Jersey protocols did not specify how to allocate electricity savings by season for Energy Star homes in the Residential New Construction program. We applied the allocation factors specified under the Comfort Partners Low Income Customers program because that program also focuses on whole-home energy efficiency

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<sup>78</sup> In this and other instances, NJ CEP had access to more extensive data but could not provide the data to the project team because of confidentiality concerns. With appropriate confidentiality agreements, such information might be used in a future analysis.

<sup>79</sup> In 2004, there were 16,986 CAC units and 339 heat pumps, saving 15,499 MWh of electricity. If electricity savings are proportional to the number of units, CAC savings are 15,196 MWh and heat pump savings are 303 MWh. Information on the capacity of units installed was not available; a directional bias, such as heat pumps tending to have larger capacity than CAC units, would produce slightly different results.

improvement.<sup>80</sup> For Energy Star homes, employing energy modeling software to generate an estimate of summer and annual electricity savings would be preferable and not burdensome.

New School Construction & Retrofit was another area of interest that lacked data. Some schools could be closed during most of the summer season and thus be a marginal source of summer season electricity savings. However, we were informed that many schools in New Jersey, particularly new schools or those that were renovated during the program, would continue to be used during the summer for a variety of programs. We therefore assessed schools according to the *OTC Workbook* factor for Commercial Comprehensive New Construction Design.

The project team also identified analytical challenges that will need to be addressed with respect to combined heat and power (CHP) projects. At the time of our review, no CHP systems had been installed under the NJ CEP, but several had been approved for funding. When New Jersey officials begin to evaluate potential NO<sub>x</sub> emission reductions from CHP, they will need to address the following issues:

- CHP projects usually result in some additional emissions of NO<sub>x</sub>, which have to be measured or calculated, to determine the net emission reductions.
- The energy savings are variable, depending on season and the allocation of the energy savings between electricity and process heat.

We recommend that New Jersey officials develop a data collection and analysis protocol to facilitate analysis of the CHP technology.

## **5.2 Degradation Factor**

The Clean Energy Protocols include assumed system lifetimes. In many cases, New Jersey officials have accounted for system degradation by shortening the estimated system lifetimes or adjusting the deemed energy savings. We recommend using an annual degradation factor rather than fixed lifetimes to better reflect degradation in the near term.

An annual degradation factor also helps to account for the fact that some equipment is removed before the end of its useful life. Commercial buildings may be renovated, or new tenants may override the high-efficiency lighting or HVAC controls.

## **5.3 Renewable Energy**

The RE analysis encountered numerous challenges, including limitations on available data and the need to supplement the New Jersey data with additional data sources. In analyzing solar electric generation, the project team supplemented the data provided by NJ CEP with a model developed by NREL to estimate electricity generation from the solar PV systems. Since no metered data were readily available to us for any of the solar generation funded under the CORE

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<sup>80</sup> This factor allocates the electricity savings as follows: summer/on-peak 21%; summer/off-peak 22%; winter/on-peak 28%; and winter/off-peak 29%. Because electricity consumption in New Jersey peaks during the summer season, and because the summer season (May–September) takes up 42% of the year, we consider it conservative to allocate 43% of the energy savings to the summer period.

program, the project team employed the PVWATTS Version 2 Tool to meet this need.<sup>81</sup> The PVWATTS calculation was based on typical solar radiation from a location in south-central New Jersey. Other locations were examined as well: the highest resource location in the state showed summer generation as 4% higher; the lowest resource location showed summer generation as 4% lower.

NJ CEP collects data through a sampling process of PV systems that are 10 kW or larger for SREC trading. The program is considering a more active remote-reading approach to encompass a broader range of systems. Comparing the projected summer production from our analysis with the observed summer production from the NJ CEP sampling would be advantageous.

The team also employed the PVWATTS default factors to allow for power to be converted from DC to AC. This tool requires information about the direction of orientation and angle of tilt for the PV system considered. NJ CEP requires applicants to provide this information to receive a rebate, and tracks this information in a database. Because there were 344 systems, the project team grouped systems into categories of orientation and inclination to facilitate use of the PV WATTS tool. System orientation and inclination have a greater impact for year-round than for summer generation.

NJ CEP data were insufficient to provide a reasonable estimate of electricity generation and NO<sub>x</sub> emission reductions during the summer ozone season in 2005 from a wind project and two biomass (landfill gas) projects funded by the agency. For the wind project, the location, height, and type of equipment are critical to estimating ozone season generation. Actual records of generation are preferred for making this determination, and were not available to us. The importance of these site-specific protocols will increase as additional wind projects come on line.

Estimating the electric generation from landfill gas projects also requires site-specific data, which were not available to the project team. Actual generation is almost always metered, and those data could be made available in the program records. Landfill gas combustion emits significant direct NO<sub>x</sub> emissions, which must be compared to the emissions that are avoided when flaring is eliminated.<sup>82</sup> This comparative analysis could not be performed because the emission rates from the specific combustion systems were not available to the project team. In projecting future emissions from landfill gas, the rate of decline in landfill gas releases from the specific landfills over time need to be forecast.

The data available to the project team on the fuel cell projects funded by the NJ CEP were insufficient to estimate the 2005 generation and to determine whether such projects qualified as RE sources. The second problem has been resolved. NJ CEP has indicated that: "After a program modification in early 2004, only sustainably-fueled (landfill gas) fuel cells are eligible for rebates."<sup>83</sup> Generation records and technology-specific data also will be required to estimate generation and net avoided emissions of fuel cell projects.

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<sup>81</sup> See p. 10 (infra).

<sup>82</sup> We understand that private companies have sought allowances for certain landfill gas projects. How they resolved these analytical issues is unclear.

<sup>83</sup> *New Jersey Clean Energy Programs Report*, submitted to the New Jersey Board of Public Utilities, May 6, 2005, p. 30.

## 6.0 Lessons Learned

The MARO pilot project provides numerous lessons learned about emissions trading programs that are applicable to other states. These lessons involve issues of regulatory policy as well as methodological approaches.

First, the project underscores the importance of the state regulatory framework that governs NO<sub>x</sub> emissions trading. If state regulations limit the allocation of allowances to only fossil fuel-fired generating units, the state and local government agencies will be precluded, for all practical purposes, from obtaining SIP credit for RE or EE purchases or development. In other words, unless the state's NO<sub>x</sub> trading regulations provide a pool of allowances to reward RE and EE development or purchases and provide a mechanism for lowering the total cap of allowances, an important market driver and revenue stream for RE and EE will be lost.

State focus on NO<sub>x</sub> allocation regulations is particularly timely. EPA's new CAIR requires most states in the ozone transport region to submit to EPA enforceable plans by September 2006 for complying with the CAIR requirements. The new CAIR requirements will replace the state regulations under the NO<sub>x</sub> SIP Call for electric generating units and will govern NO<sub>x</sub> allowance allocation in 2009 and thereafter for such units.

The pilot project underscored several regulatory options that provide a pool of NO<sub>x</sub> allowances to encourage EERE measures. These options include:

- Allocate a percentage of NO<sub>x</sub> allowances into a so-called RE and EE set-aside to encourage RE and EE measures.
- Allocate a percentage of NO<sub>x</sub> allowance into a so-called attainment/public health reserve.
- Allocate allowances to all sources on an output basis (tons of emissions reduction per MWh) instead of a heat-input basis (used currently in most states and which covers only electric generators that burn fossil fuels).
- Allocate allowances to new sources on an output-basis.<sup>84</sup>

A recent document prepared by the State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO) highlights these options.<sup>85</sup>

In addition, lessons learned from RE and EE set-aside regulations under the NO<sub>x</sub> SIP Call are helpful in crafting new CAIR rules for NO<sub>x</sub> trading. These lessons are highlighted in an EPA draft report titled *State Set-Aside Programs for Energy Efficiency and Renewable Energy*

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<sup>84</sup> This approach was adopted by the National Association of State Regulatory Commissioners in a resolution in the summer of 2004. This approach can encompass energy efficiency if a conversion factor is specified in the regulation.

<sup>85</sup> "Alternative NO<sub>x</sub> Allowance Allocation Language for the Clean Air Interstate Rule," August, 2005. See [www.4cleanair.org/Bluestein-cairallocation-final.pdf](http://www.4cleanair.org/Bluestein-cairallocation-final.pdf).

*Projects Under the NO<sub>x</sub> Budget Trading Program: A Review of Programs in Indiana, Maryland, Massachusetts, Missouri, New Jersey, New York, and Ohio.*<sup>86</sup>

The pilot project and these two recent reports underscore several important provisions that states should consider including in new CAIR rules that provide allowances to spur EERE. These provisions include:

- Authority for a developer and the state to aggregate small projects in an application for allowance allocation. For example, small solar PV projects alone will not qualify for allowances since such projects result in emission reductions far lower than one ton (the minimum allocation in most states). If project aggregation authority is not provided in the state rules, the RE and EE set-aside will likely be underused.
- Authority for a state energy office that administers incentive programs to apply for allowances relating to state-funded clean energy projects for owners and operators who have not applied on their own behalf. The state energy office could then retire these allowances to obtain SIP credit.

The pilot project highlights various methodological approaches that can facilitate the implementation of state regulations to reward RE and EE. Other states can benefit from employing some or all of the methodologies developed by the NJ CEP (and refined and expanded by the pilot project) to determine the emission reductions achieved by RE and EE measures. New Jersey's clean energy protocols and incentive allowance regulations allow NO<sub>x</sub> emission reductions to be estimated with a relatively small investment.<sup>87</sup>

States may want to consider the following specific methodological approaches in their CAIR regulations to facilitate the integration of energy and air quality goals:

- Employ protocols with stipulated electricity savings to assess the benefits of specific EE measures and use the New Jersey clean energy protocols as a starting point. Some variables may need to be adjusted, depending on the specific state and region (e.g., the assumed equivalent full load hours of operation of an air-conditioning unit), but the equations included in the protocols appear to be sound and transferable.

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<sup>86</sup> EPA, Climate Protection Partnerships Division, Office of Atmospheric Programs, Office of Air and Radiation, EPA Document No. 430-R-03-005, September 2005, available at [http://www.epa.gov/cleanenergy/pdf/eere\\_rpt.pdf](http://www.epa.gov/cleanenergy/pdf/eere_rpt.pdf).

<sup>87</sup> When using a simplified approach, such as that employed by the pilot project, be conservative in assumptions and default values.

States may alternatively follow an approach developed by the Texas Energy Systems Laboratory (in partnership with EPA) that is more detailed and includes more in-depth analysis. This latter approach may result in a greater emission reductions credit but at a much higher cost. This methodology, which identifies county-level emissions impacts of RE/EE measures based on the county in which the measure was implemented, is both possible and necessary in a state with regions that are not subject to NO<sub>x</sub> caps. (*Emissions & Energy Calculator* (eCalc), Energy Systems Laboratory, Texas A&M University. See <http://ecalculator.tamu.edu/>.)

- Employ a stipulated avoided emissions rate (lb/MWh) for RE and EE measures that is based on the generation-weighted average NO<sub>x</sub> emissions rate of the relevant region's variable dispatch fossil fuel plants.
  - The CAIR regulations could require that the state update this stipulated allocation rate periodically to reflect changes in the composition of the fuel mix and control technologies. (This approach would significantly reduce the resources required to analyze specific facilities.)
  - In addition, the state's CAIR regulations could, if adequate evidence is presented, grant the state air agency authority to approve a higher allocation rate than the stipulated amount. (This approach allows parties who are responsible for developing large RE or EE projects to devote greater resources and claim higher actual emissions reductions.)
- Include seasonal allocation factors that define assumed electricity savings for specific types of measures in state protocols.
- Seek to fulfill the requirements for Energy Star ratings for residential construction and renovation and employ Energy Star energy modeling for home EE improvements. This approach can ascertain the likely effect of a combination of efficiency measures and will help promote the Energy Star brand.
- Determine electricity savings for specific measures by comparison to a typical new system for that load, and define the reference system in protocols. Determine electricity savings for comprehensive building improvements through energy modeling with an energy code as a reference.
- Examine the state's emission inventory and SIP and identify any assumptions about RE and EE that are already in the inventory. If the state intends to rely on RE/EE measures for SIP credit, it must ensure those measures are surplus to those included in the baseline.

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<b>14. ABSTRACT (Maximum 200 Words)</b> The MARO pilot project represents the first effort in the country to seek to obtain credit under a Clean Air Act (CAA) State Implementation Plan (SIP) for nitrogen oxide (NOx) emission reductions. This project came about because of state-funded incentive programs and projects for RE and EE. Specifically, the pilot project focuses on the New Jersey (NJ) SIP and efforts to facilitate attainment of the new, 8-hour ozone standard under CAA by implementing selected categories of RE and EE programs and projects funded by the New Jersey Clean Energy Program (NJ CEP) of the New Jersey Board of Public Utilities (NJ BPU).						
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